XIV. *Butterfly Migrations in British Guiana.** By L. D. Cleare, Jnr., F.E.S., Biological Division, Dept. Science & Agric., British Guiana.

[Read November 3rd, 1920.]

Migrations of butterflies occur from time to time in British Guiana, and many of the inhabitants can recollect having seen such phenomena, yet in most cases neither year, month, nor any other useful data can be supplied. Occasionally naturalists have recorded migrations when observed by themselves, but of records of this kind there are but few. In the Transactions of the Entomological Society for 1917 Mr. C. B. Williams, in a paper entitled "Some Notes on Butterfly Migrations in British Guiana," describes two such migrations observed by himself whilst on a visit to the colony in 1916; besides these Mr. Williams gives a number of observations supplied by inhabitants on other migrations, as well as some previously published accounts—in all sixteen migrations are recorded.

"It is difficult," says Mr. Williams, "even from the above records to get any indication of what is happening. On the real problem, why the migration takes place, there is still no light, and many more correlated observations must be made before there can be any hope of solving it." Mr. Williams adds, "British Guiana would seem to be a promising field for such investigations, but they must be extended over a series of years, with a number of competent observers stationed over the country."

As so little is known about these migrations, it seems advisable to record all observations until we can at least form some theory about them. It is with this object in view, as well as to form a continuation to Mr. Williams' paper, that the following observations are offered.

It has recently been my good fortune to witness one of these migrations at Georgetown, and it is here proposed to give the details connected with it, together with a number of other observations, collected from reliable sources, on

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other migrations, none of which have been recorded by Mr. Williams in his paper, or elsewhere, as far as I am aware. The majority of the records would, I presume, refer to *Callidryas eubule* L., the common sulphur-yellow butterfly of the colony, but there is also a record of a migration of *Pieris phileta* F., as well as one of *Catopsilia statira* Cram.

The localities and direction of these migrations are in every case indicated on the accompanying map. The signs used by Williams in recording a migration of *Catopsilia statira* in a recent number of the Trans. Ent. Soc. (1919, p. 76) have, for the sake of uniformity, been used in the map illustrating this paper.

Callidryas eubule L.

1. About 1.45 p.m. on March 18, 1919, Mr. A. Seton Milne, Government Veterinary Surgeon, on his arrival at the office drew my attention to the number of yellow butterflies about. On looking out it was obvious that a migration was taking place. No such migration was going on at 11.30 that morning. Mr. Milne informed me that he first observed these insects about 1 p.m. in Croal Street. He said that they were then more numerous than at the time when I saw them. I immediately left for Croal Street to make observations. The butterflies could be seen everywhere between this laboratory and Croal Street, a distance of half-a-mile north, and as the insects were travelling in an easterly direction the width of the swarm was at least that.

At 1.55 p.m. I noted that the butterflies were not passing in a continuous stream, but in twos and threes, and sometimes larger numbers. The direction of the flight was due east, and they were usually between six and twenty feet off the ground.

From my point of observation I could look over a width of about 120 yards, and the butterflies crossing this area were counted. During the first minute of observation thirty-three insects crossed. After that the count was made every five minutes. The results were as follows :—

1st 5 minutes	100 butterflies passed	=	20·0	per minute.
2nd ,,	95 ,, ,,	=	19·0	,,
3rd ,,	40 ,, ,,	=	8·0	,,
4th ,,	63 ,, ,,	=	12·6	,,

This works out at an average of 14·9 butterflies passing every minute.

It will be noticed that the number of these insects passing gradually decreased except in the last five minutes, but even then it was considerably less than at the beginning of the observation.

At 2.20 p.m. observations were started at another point about 650 yards east of the first position and about 80 yards further south. The distance over which the insects were counted was about the same as in the previous instance. Here 143 butterflies crossed the area in five minutes, making an average of 28·6 per minute, a number which was only exceeded during the first minute of observation.

To get some idea of the speed at which the butterflies were travelling, a distance of about 22 yards was paced off between two fences, and the insects crossing this space were timed from the moment they mounted one fence till they arrived at the next. Eight insects, taken at random, were thus timed; they all crossed the distance in about five seconds. This gives a speed of about 9·0 m.p.h.

By 2.30 p.m. the decrease in the number of butterflies was very noticeable, and I returned to the laboratory. By 2.45 p.m. the migration had ceased.

The next day I wrote a letter to both local newspapers asking any one who observed this migration to communicate with me. Concerning this particular migration I got but one observation, though there were a few relating to other migrations.

The late Mr. John Cunningham, Editor of the "Daily Argosy," informed me that while motoring along the East Coast, Demerara, on that day he observed large numbers of yellow butterflies in the vicinity of Paradise, which is about 16 miles from Georgetown, going in an easterly direction. On his arrival in Georgetown about 1.30 p.m. he noticed them too. From this we may conclude that the swarm was at least 16 miles in length.

The facts concerning this migration may be summarised as follows :—

Duration of migration . .	about $2\frac{3}{4}$ hours.
Direction of migration . .	East.
Prevailing wind . . .	N.E.
Speed of wind . . .	12·50 m.p.h.
Speed of migration . .	9·0 m.p.h.
Average number of insects crossing an area of about 120 yards wide	14·9 to 28·6 per min.

An idea of the number of butterflies, even in a small migration like this, may be gained by making a rough estimate. Taking twenty butterflies per minute, crossing a width of 120 yards, and taking the width of the swarm to be about half-a-mile, this would give 8,760 butterflies crossing per hour. This migration lasted for two and three-quarter hours, which would give about 24,090 butterflies in the swarm, and this would be a conservative estimate.

Unfortunately none of the insects were captured, so I can give no information as to the percentage of the sexes. The species concerned, however, may, I think, be safely put down as *Callidryas eubule* L.

2. Mr. B. H. Gainfort, of Sprostons, Ltd., describes having seen a very extensive flight of yellow butterflies, which, as far as I know, is the broadest swarm on record. He writes : " It was on the 6th July, 1912, going up the Demerara River that we passed through a swarm of orange-coloured moths (*sic*) so thick that we caught several hundred of them from the deck of the steamer ' Essequibo.' We entered the swarm somewhere between Diamond and No. 1 Island and got out of it somewhere about Dalgin. I estimated at the time that it was about 30 miles wide—flying from west to east. These moths (!) were in evidence a day or two afterwards on the Essequibo and Potaro Rivers." Obviously these " moths " were *Callidryas*.

Mr. E. E. Winter, B.Sc., Geological Surveyor of this Department, has given me several observations. They are particularly interesting on account of their being made in the interior of the colony, and on account of Mr. Winter's observation of their association with dry weather.

Mr. Winter tells me that such migrations can invariably be seen on the rivers during the dry season. Practically on every trip he makes some such swarm is observed, but the ones mentioned here stand out distinctly in his memory above all others. They may be taken as typical examples.

3. Mazaruni River, Makari Falls, October 1911. Dry season. Mr. Winter was camped on one of the islands in this fall. He observed " yellow and washed-out green " (? males or *Pieris*) butterflies crossing the river for about eight hours, say between 7.30 a.m. and 4 p.m. The insects were flying in twos and threes with varying distances between them; they could never be described as a thick cloud. Owing to the position of his camp, in one

of the side channels of the fall, Mr. Winter is unable to give the direction of the flight. This was the first such migration Mr. Winter witnessed.

4. Essequibo River, Mocco-mocco Point, February 1914, Mr. Winter says: "I was camped there for two or three days and on one day there was a stream of these yellows coming across the river from east to west in twos and threes with gaps between. The flight lasted all day—say between 7.30 a.m. and 4 p.m." From the position of his camp Mr. Winter is unable to give an idea of the width of the swarm.

5. Mr. G. F. Messervy, of the Department of Lands and Mines, who has been stationed at Christianburg on the Demerara River for the past three years, gives me the following observation.

He observed a migration of yellow butterflies in May or June 1916, on the Demerara River about 140 miles from its mouth. The insects were flying from west to east in batches of about twenty or so. They were yellow mixed with some paler-coloured ones. This was about the beginning of the wet season. Mr. Messervy cannot say definitely whether it was in May or June that he observed these insects.

Resting in Patches.

The four following observations by Mr. Winter on the resting of these insects in patches are interesting. As to whether they were obtaining some nourishment from the sand in the form of salts is problematical, but the suggestion made by Williams with regard to the urine from animals would certainly not hold good in at least the last three instances, whilst even in the first it is hardly likely, for not more than a couple of animals—mules—pass along this road each day.

6. Potaro Road, 7½ miles from Potaro Landing. September 1915. Dry season. A number of yellow and greenish-white butterflies, some with a distinct orange tinge, were resting in the middle of the road in bright sunlight on a sandy patch over an area of about ¾ to 1 square yard. The butterflies seemed to be collecting at this spot from both sides of the valley out of the forest. (The Potaro Road is in the Mahdia Valley between Eagle Mt. and the Kaiteur Mountains.) The insects were packed close together,

and as the buggy drove through the swarm they were disturbed, and striking against the spokes made a decided tapping sound. The insects alighted on the same spot after the buggy had passed a few hundred yards.

7. Mazaruni River, Sansankopai. Yellow butterflies were clustered together on a sandbank on an island in the middle of the river. The patch was not as large as the Potaro patch mentioned above. Mr. Winter cannot give the date of this observation.

8. Yawakuri River, June 1919. A small boat that had sunk in the river was partially exposed and on one of the exposed parts was a small patch of sand, deposited while the river was much higher. The sand was then quite dry, and in strong sunlight. On this small patch of sand about a dozen yellow butterflies had collected.

9. Pomeroon River, Issururu Creek, March 1920. A large tree had fallen and was stretched across the creek, supported on one side by its roots and on the other by the thick mass of branches, it was in this way not submerged. Some of the branches, however, were in the water, and around these a small sandbank had gradually formed. A part of the bank was well above water, and quite dry, so dry that the sand was beginning to blow; it was also in the full heat of the sun. On this patch of sand about twenty yellow butterflies had collected. Mr. Winter first observed them about 9 a.m., and on his return to camp about 5 p.m. they were still there. Occasionally one of the butterflies would leave the swarm and fly off to one of the nearby trees, but in a few minutes it would return again.

Catopsilia statira Cram.

10. Mr. A. A. Abraham, Horticultural Superintendent of this Department, while engaged on an agricultural survey of the Rupununi Cattle Trail, collected five butterflies from a migration which took place on the Yawakuri Savannahs on June 16, 1919, and forwarded them to the Biological Division. These insects proved to be *Catopsilia statira* Cram., and were all males.

In a letter to me he says: "The specimens I collected were taken on the wing and the flight was then directly across the Yawakuri Savannahs; the migration was also across the Berbice River. . . . The insects were travelling in very large numbers and with a steady flight, but I do not

think they were so thick as to constitute a cloud." He adds, "The insects were flying in a south-easterly direction; the direction of the wind being north-east."

He further states: "As far as my observations extend I have noticed that the butterflies always appear during the months of June, July, and August, and sometimes their migration continues in the early part of September if the weather remains dry. The flight ceases if it should rain during the migration. The insects always travel at right angles to the wind." These observations were made in the North-West District at Issororo, and may be taken to apply to *Callidryas*.

Pieris phileta F.

11. My father supplies the following observations on a large migration of *Pieris phileta* F., which he witnessed on the Courantyne Coast, Berbice, in September 1919.

About the middle of September he saw a migration of butterflies taking place at Albion Magistrate Court, which is about 12 miles from New Amsterdam. The insects were present in very large numbers, and in giving an idea of the density he estimated that there were about 10 insects to the square yard, and added that to say they were like falling snow would certainly describe the appearance. The insects were present as far down the coast as Bramfield, which is 4 miles from New Amsterdam, so that the swarm was about 8 miles wide. The insects were flying towards the foreshore —that is, in a northerly direction. This would be across the prevailing wind, which is usually north-easterly, but on this point he can give no definite information.

On the following day he again observed them at Whim, about 6 miles further up the coast, and about 18 miles from New Amsterdam. The insects were just as numerous as on the previous day, and on this day several were collected against the glass windows in the rest house. They all proved to be *Pieris phileta* F. Of eighteen insects collected in this way ten were males, while eight were females. This migration took place between 8 and 11 a.m.

On making inquiries from the Police in the district he was informed that such migration had been going on for the past week or ten days, and that they often occurred in that district.

During this year I have bred the insect in Georgetown

on the food-plant *Cleome polygama* L., while Mr. H. W. B. Moore has bred it on *Cleome speciosa* Kth., cabbage, mustard, and horse-radish; all closely related plants.

While this insect occurs in the county of Demerara it is far more common in Berbice, where it can usually be seen, and where its migrations only appear to take place; in the same way the *Callidryas* are more or less confined to the Demerara and Essequibo districts.

Summary.

It will be observed that three of the migrations of *Callidryas* were from west to east. First the one observed by Mr. Gainfort in 1912, then the one seen by Mr. Messervy in 1916, and lastly, the one which I witnessed in March 1919. Mr. Williams points out in his paper that the general direction of such migrations was from north-west to south-east and *vice versa*, and the three migrations mentioned above may be taken as agreeing with this in a general way. He adds, however: "There is yet no record of a migration in a north-east or south-westerly direction." The migration observed by Mr. Winter at Mocco-mocco Point, Essequibo River, in February 1914 was from east to west, practically just the opposite direction to all previous records, and to Mr. Williams' remark quoted above.

Mr. Williams also says: "Secondly, all migrations of *Callidryas* in which date is recorded took place between May and October." The migration which I observed took place on March 18th, while Mr. Winter observed one in February 1914.

A very interesting point which was brought out by Mr. Winter's observations is that such migrations are of frequent occurrence in the dry season. He says that the generally accepted opinion is that such migrations *precede* dry weather. Again, the recent migration proved to be an exception, for it occurred when the rainfall was above the normal for the year, and this condition continued for some weeks after.

Mr. Williams in his paper on the migration of *Catopsilia statira* suggests that the reason for these insects settling in patches on the ground is for the purpose of obtaining nourishment in the form of salts from areas "where the urine from animals passing along the road had recently dried up." This theory would certainly not hold good in at least three of the instances given here—Nos. 7, 8, and 9—as in these places there are no such animals, while in the